520 Rec'd PCT/PTO 19 APR 2000

FORM PTO-1390 (REV. 12-29-99) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER: MSI-27

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5): 09/529771

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/IB98/00999	29/06/1998	30/06/1997

TITLE OF INVENTION: Security Thread

APPLICANT(S) FOR DO/EO/US: Brian CHORLEY; Richard Hunter BROWN; Joseph Francis YASKOWSKI

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [X] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). (unsigned)
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [ ] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [X] A change of power of attorney and/or address letter.
16. [X] Other items or information:

Power of Attorney (3 sheets)
Postcard

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/529771	PCT/IB98/00999	MSI-27

17. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$970.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$840.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$690.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$670.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$96.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 840.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	6 - 20 =	0	X **$18.00**	$
Independent claims	1 - 3 =	0	X **$78.00**	$
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$260.00**	$ 260.00
TOTAL OF ABOVE CALCULATIONS =				$
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also by filed (Note 37 CFR 1.9, 1.27, 1.28).				$
SUBTOTAL =				$
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$
TOTAL NATIONAL FEE =				$
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$
TOTAL FEES ENCLOSED =				$ 1100.00
			Amount to be refunded:	$
			charged:	$

a. ☒ A check in the amount of $ 1100.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-1057. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Edward J. Howard, Esq.
Buchanan Ingersoll PC
650 College Road East
Princeton, NJ 08540

SIGNATURE: _____

NAME Edward J. Howard

REGISTRATION NUMBER 42,670

SECURITY THREAD

This invention relates to a security thread for protecting documents, banknotes, or identification cards against forgery.

In banknotes, it is common to find security threads in the form of thin strips imbedded in paper, such strips of a magnetic material provided with magnetic coding. The strip may be provided with a metallised layer either side of the magnetic material, the metallisation also used to print fine characters as a further security feature. As mechanical support and protection, the magnetic material and metallisation layers are sandwiched between plastic (polyester) layers.

It is also known to provide piezoelectric film in security documents as described in US 4,763,927 or US 4,792,667, the presence of piezoelectric material being detectable by mechanical or pyroelectric testing means. In US 4,792,667, pre-poled films of polymeric material made from polyvinylidene fluoride (PVDF) or other polymeric piezoelectric materials are fixed to documents for security. Piezoelectric films with poled regions may not provide sufficient security for certain documents such as banknotes.

It would be desirable to further enhance the security against forgery of security threads. It would also be advantageous to provide additional features in a security thread that enable easy detection or that provide a redundant control in the event the primary security feature is defective. It is desirable to provide security means that are well adapted for manufacture in large quantities, and which are cost-effective to manufacture whilst enhancing security against forgery, reliability, and ease of detection.

It is an object of this invention to provide an improved security thread with enhanced security against forgery and ease of detection.

Objects of this invention have been achieved by providing the security thread according to claim 1. Disclosed herein is a security thread comprising a magnetic layer sandwiched between protective layers, wherein at least one of the protective layers is a piezoelectric polymer. Advantageously therefore, a particularly compact and cost-effective security thread is provided with enhanced security features. The magnetic material may be coded as is typical for conventional security threads, wherein the piezoelectric polymer layer may also have a series of juxtaposed poled and unpoled regions. The poled and unpoled regions may form a binary code such that both the magnetic and the piezoelectric layers have coding means; the magnetic layer being readable by a magnetic head, and the piezoelectric layer readable by a conductor or capacitive receptor after stimulation of the piezoelectric poled regions by mechanical (e.g. ultrasound) or pyroelectric (e.g. infrared rays) transmitters. On either side of the magnetic layer, there may be provided a metallisation layer, one of the metallisation layers thus being sandwiched between the magnetic layer and the piezoelectric layer and forming an electrode for the piezoelectric poled regions, in particular forming the ground electrode. The metal layer is reflective to light thereby concealing the magnetic layer, and forms a base for printing characters that can be read when light is passed through the metallisation layer. Compound security measures can thus be provided in a particularly compact security thread, requiring various detection means that enhances security against forgery.

Further advantageous aspects of the invention are set forth in the claims, or will be apparent from the following description and drawings.

Embodiments of this invention will now be described by way of example, with reference to the figures in which;

Figure 1 is a cross-sectional view through a security thread according to this invention, the thread shown partially laminated;

Figure 2 is a view similar to Figure 1 different embodiment according to this invention.

Figure 3 is a simple schematic view representing dipoles in a portion of piezoelectric layer taken in cross-section; and

Figure 4 is a simple schematic view illustrating how a piezoelectric layer is polarised.

Referring to Figure 1, a security thread 2 is shown in longitudinal cross-section. The security thread may be of substantially similar shape and dimension as a conventional security thread embedded in banknotes or security documents, for example in the form of a thin elongate thread traversing a banknote. The security thread 2 comprises a magnetic layer 4 sandwiched between polymeric layers 6, 8 either side of the magnetic layer 4. The polymeric layers 6, 8 may be of different materials, for example a first layer 6 being of simple polyester or other flexible plastic material, and the second layer 8 being of a piezoelectric material such as polyvinyldene fluoride (PVDF) or other piezo electric polymeric material. It is also possible to provide the second layer 8 as a simple flexible plastic layer such as polyester, coded or printed on one side thereof with a piezoelectric material such as polymer(VDF/TrVE) or vinylidene/tetrafluoritheylene co-polymer (VDF/TFE).

The flexible polymeric layers 6, 8 are also protective layers that support and protect the magnetic layer 4 therebetween from mechanical damage. The magnetic layer 4 may be coded magnetically along its length (direction L) such that each security thread has a distinctive magnetic code readable by a detection device having a magnetic head. The magnetic layer 4 is shown in Figures 1 and 2 as a layer separately laminated between the polymeric layers 6, 8, but the magnetic layer may also be printed or deposited otherwise on one of the polymeric support layers 6, 8, for example the simple polymeric (polyester) layer 6. The polymeric layer 6 with the deposited magnetic layer 4 would then bonded to the other polymeric layer 8 by means of a conventional adhesive.

A metallisation layer 10 is provided between the magnetic layer 4 and the piezoelectric layer 8. The metallisation layer 10 may be deposited on the piezoelectric layer 8 by sputtering or other conventional metal deposition methods for deposing metals on substrates or the like. The metallisation may also be etched in certain places to form characters that are readable when light is shone through the security thread. The electrode 10 further acts as a ground electrode for contacting an inner side 11 of the piezoelectric layer 8 to ground, the opposing other side 12 of the piezoelectric layer 8 being readable by a detection device, for example a conductive member biased thereagainst. When subject to mechanical deformation, piezoelectric material produces electrical charges, an electrical potential thus being developed between the inner and outer layers 11, 12. The electrical charge that develops can either be read by an electrical detector connected to the ground electrode 10 and the charge

electrode layer 12, or by capacitive detection means that responds to the electrical field created by the electrical charges. Piezoelectric materials such as PVDF also have a pyroelectric effect, whereby when subject to heat (for example from a light source emitting infrared) the heating of the piezoelectric creates an electric potential between the opposed layers 11, 12. Detection of the pyroelectric effect may for example be effected by the detection device described in International Application WO 97/07478.

As shown in Figure 1, the polymeric layer 6 may also be provided with a metallisation layer 14 on its inner side 15. This metallisation layer may similarly be provided with characters.

In the embodiment of Figure 1, the piezoelectric layer 8 is substantially uniformly charged (poled) piezoelectrically along the whole length thereof. As illustrated in Figure 2, in a second embodiment the piezoelectric layer 8 is provided with a series of poled regions 16 and unpoled regions 18. The poled and unpoled regions may have lengths that are multiples of a smallest bit length, as depicted in Figure 2 by the poled region 19, such that the piezoelectric layer 8 has a binary code extending along its length L. By mechanical excitation such as ultrasound, a conductive or capacitive detector can pick up the electrically charged areas along the length, thereby reading the binary code.

It is also possible to charge piezoelectric material such as PVDF, either negatively or positively such that certain of the poled regions are positive and certain of the poled regions are negative. In this way, it is also possible to provide a tertiary code rather than a binary code. The latter is illustrated in Figure 4 which schematically illustrates the dipole orientation in a

portion of polymeric piezoelectric layer. The horizontal dipoles 20 indicate a non-piezoelectric area and the vertical dipoles 21, 22 represent respectively negative and positively poled areas.

The coded piezoelectric layer 8 of the embodiment of Figure 2 can be made by positioning a ground electrode 24 against one side of the layer 8 (for example the metallised ground layer 10) and positioning charge electrodes 26 on the charge side 12 of the layer 8. The charge electrodes 26 may be provided with a high positive or negative voltage depending on whether positive poled regions or negative poled regions are desired. The charge electrodes 26 may be held together in a single structure, with a dieletric (such as a ceramic or air) separating the poling regions. The electrodes may be provided on a rotating drum, the grounded electrode forming a opposed rotating drum with the piezoelectric layer sandwiched therebetween such that a continuous lamination of the piezoelectric layer 8 with piezoelectric poling can be effected.

As illustrated in Figure 2, the first polymeric layer 6 may also be a piezoelectric layer, for example charged with a binary code that may either differ from the binary code of the layer 8 as indicated by the piezoelectric charged regions 16' and immediate non-charged regions 18'. It is also possible to provide the first layer 6 with the same binary code as the second layer 8 to enhance the reliability in the event one of the layers is defective. The second metallisation layer 14 could also act as the ground electrode for the piezoelectric layer 6 in a similar manner to the ground electrode for the piezoelectric layer 8.

A particularly compact security thread with enhanced security is thus provided. The means of detecting the

security thread based on different physical effects such as the magnetic field of the magnetic layer 4 and the electrical field or potential differences of the piezoelectric layer or layers 6, 8, significantly increases difficulty of forgery.

CLAIMS

1. A security thread comprising a magnetic layer sandwiched between protective layers, wherein at least one of the protective layers comprises a piezoelectric polymer.

2. The security thread of claim 1 wherein the piezoelectric polymer layer has poled and unpoled regions forming a binary or tertiary code.

3. The security thread of claim 1 or 2 wherein a pair of the protective layers, one either side of the magnetic layer, is a piezoelectric polymer.

4. The security thread of claim 3 wherein each of the piezoelectric layers has poled and unpoled regions.

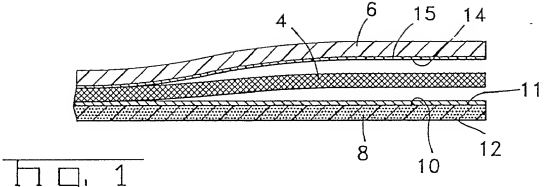
5. The security thread of any one of the preceding claims wherein the thread further comprises a metallisation layer between the piezoelectric polymer layer and the magnetic layer.

6. The security thread of claim 5 wherein the metallisation layer acts as a ground electrode for the piezoelectric layer.

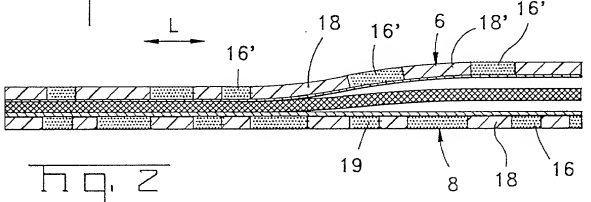
ABSTRACT

A security thread 2, for identification of security documents such as banknotes, has a magnetic layer 4 sandwiched between polymeric layers 6, 8, where one of the layers 8 is a piezoelectric layer such as PVDF. The piezoelectric layer 8 may be poled intermittently such the piezoelectric layer is coded. A particularly compact security thread with enhanced multiple coded features is thus provided.

1/1



Фиг. 1



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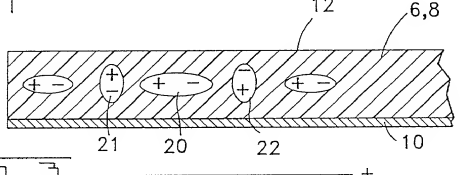

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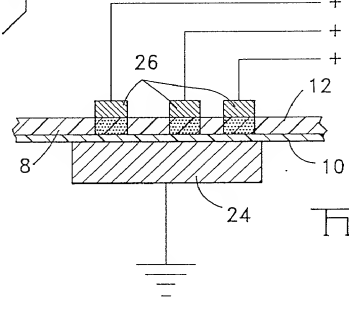

Фиг. 4

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	MSI-27
First Named Inventor	Chorley et al.
COMPLETE IF KNOWN	
Application Number	09/528,771
Filing Date	6/19/00
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on this invention entitled:

SECURITY THREAD

(the specification of which)
☐ is attached hereto
OR
☒ was filed on (MM/DD/YYYY) 6/19/00 as United States Application Number or PCT International Application Number 09/528,771 and was amended on (MM/DD/YYYY) ☐ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? Yes	No
9713850.7	Great Britain	6/30/97	☐	☐	☒
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

Burden Hour Statement: This form is estimated to take 0.4 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

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DECLARATION — Utility or Design Patent Application

I believe I am the original, first and joint inventor (if plural inventors are named) of the subject matter which is claimed and for which a patent is sought on the invention entitled (Title of Invention)

U.S. Patent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)
PCT/IB98/00995	6/29/98	

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

☐ Customer Number [ ] → Place Customer Number Bar Code Label here

OR ☒ Registered practitioner(s) (name/registration number listed below)

Name	Registration Number	Name	Registration Number
Arthur L. Plevy	24,277	Paul A. Schwartz	37,522
Edward J. Howard	42,670	Jane E. Alexander	36,014
Jonathan M. Darcy	44,054		

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label [ ] OR ☒ Correspondence address below

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle if any)	Family Name or Surname
Brian	Chorley

Inventor's Signature	[signature]			Date	13/9/00
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City	Essex	State		Zip	IG9 5NF
Country	United Kingdom				

☐ Additional inventor(s) are being named on the ____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

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DECLARATION

ADDITIONAL INVENTOR(S) Supplemental Sheet
Page 2 of 2

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor
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Inventor's Signature	Date 9/14/2000
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Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor
Given Name (first and middle if any)	Family Name or Surname
Inventor's Signature	Date
Residence City: State: Country:	Citizenship:
Post Office Address:	
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